

# **Long-Term Variable Milfoil Management and Control Plan for LAKE MONOMONAC Rindge, New Hampshire Belknap County**

Prepared by: New Hampshire Department of Environmental Services (DES),  
in consultation with the  
New Hampshire Fish and Game Department (F&G)  
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## **PROBLEM STATEMENT**

Exotic aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000). According to the 2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM), “exotic macrophytes are non-native, fast growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Such infestations are in violation of Env-Ws 1703.19, which states that surface waters shall support and maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region” (DES, 2006).

Though exotic aquatic plants can negatively impact an aquatic system, native aquatic plants are beneficial to the aquatic ecology of waterbodies. Diverse assemblages of native aquatic plants are a source of oxygen to the system, they provide stabilizing root systems to minimize erosion and turbidity, and they provide food and habitat for aquatic life.

Lake Monomonac is a border lake between New Hampshire and Massachusetts. Variable milfoil (*Myriophyllum heterophyllum*) became established in Lake Monomonac in the 1990s. The plant has colonized several small coves throughout the lake in both Massachusetts and New Hampshire. Figure 1a illustrates the variable milfoil infestations in the southern tile of the lake map, and Figure 1b illustrates the variable milfoil infestations in the northern tile of the lake. Following is a summary of each area indicated in Figure 1a and 1b:

**Area 1-** This area is in a small cove of the lake that comprises approximately 2 acres of surface area. The infestation in this area is sparse, at roughly 15% variable milfoil density.

**Area 2-** This area is more exposed along a shoreline of a point on the lake. The area is just over seven acres in size, and the variable milfoil infestation is at 30% coverage.

**Area 3-** This is a small cove that is roughly 1 acre in size. The variable milfoil is at approximately 10% coverage in this area, but it is scattered enough to consider the whole cove for a treatment area.

**Area 4-** This infestation is a small area within a larger cove. The infestation covers 2.2 acres, with 10% scattered cover within that area.

**Area 5 and 5a-** These two areas are located on either side of Paradise Island. Variable milfoil is scattered throughout this combined 7.9 acre site, and it is present at 50% cover.

**Area 6-** Variable milfoil covers approximately 4.2 acres in this area, with 50% cover.

**Area 7-** Area 7 is the northern tip of Coot Bay. Variable milfoil here is present in small patches, but amounts to about 50% cover in the cove. The overall area is 0.6 acres in size.

In terms of the variable milfoil impacts to shorefront property owners, there are approximately 500 houses surrounding the Lake Monomonac shoreline, with roughly half of these on the New Hampshire side of the border. There are no properties on this waterbody that are considered ‘back lots’ that have lake access.

At this time, there are no data and no observable problems with the biological integrity of the aquatic community as a result of the variable milfoil infestation; however, no biological integrity surveys have been conducted as part of this plan preparation.

## **PURPOSE**

In September 2006, the Lake Monomonac Lake Association requested matching funds from the Department of Environmental Services to conduct a Diquat treatment of the variable milfoil during the spring of 2007 to control areas infested with variable milfoil.

The purposes of this exotic aquatic plant management and control plan are:

1. To identify the waterbody’s beneficial use areas, including essential aquatic habitat, designated conservation zones, swimming areas, boat access sites, and boating use areas;
2. To present the aquatic macrophyte distribution map, including both native and exotic species;
3. To identify short-term and long-term exotic aquatic plant control goals that protect and conserve the lake’s beneficial uses;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. To recommend monitoring strategies to determine the success of the control practices over time in meeting the goals.

This plan also summarizes the current physical, biological, ecological, and chemical components of Lake Monomonac and the social and ecological impacts of the milfoil infestation.

The intent of this strategic plan is to manage variable milfoil in Lake Monomonac over time through the use of Integrated Pest Management Strategies (IPM). Appendix A details the strategies available for waterbodies with exotic species, and provides more information on each of the activities that are recommended within this plan.

## **GOALS/OBJECTIVES OF MILFOIL CONTROL ACTIONS**

The aim of this project is to contain variable milfoil in Lake Monomonac. This approach is to limit the size and extent of the existing infestation. A Diquat treatment (at the request of lake residents) will be used to reduce specified areas down to a percent cover of the exotic species so

that it can be maintained or contained with alternative management strategies, including Restricted Use Areas, benthic barriers, and others. Subsequent herbicide applications in future years may be necessary if the target species shows exponential growth and further spread.

Understanding that Diquat will not eradicate variable milfoil from Lake Monomonac, the goals for containment are as follows:

- 1) In 2007, reduce the overall percent of variable milfoil bottom growth at Area 1 in Lake Monomonac from 2 acres and 15% cover to less than ½ acre and less than 5% cover using the aquatic herbicide Diquat to allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.
- 2) In 2007, monitor area 2 for any variable milfoil growth and manage this site using hand-removal and/or benthic barrier placement.
- 3) In 2007, reduce the overall percent of variable milfoil bottom growth at Area 3 in Lake Monomonac from 1 acres and 10% cover to less than 0.5 acre and less than 5% cover by hand-removing any variable milfoil plants and continuing to monitor the area for additional growth.
- 4) In 2007, reduce the overall percent of variable milfoil bottom growth at Area 4 in Lake Monomonac from 2.2 acres and 10% cover to less than 0.5 acre and less than 5% cover using the aquatic herbicide Diquat to allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.
- 5) In 2007, reduce the overall percent of variable milfoil bottom growth at Area 5 and 5a in Lake Monomonac from 7.9 acres and 50% cover to less than 0.5 acre and less than 10% cover using the aquatic herbicide Diquat to allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.
- 6) In 2007, reduce the overall percent of variable milfoil bottom growth at Area 6 in Lake Monomonac from 4.2 acres and 50% cover to less than 0.5 acre and less than 10% cover using the aquatic herbicide Diquat to allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.
- 7) In 2007, reduce the overall percent of variable milfoil bottom growth at Area 7 in Lake Monomonac from 0.6 acres and 50% cover to less than 0.25 acre and less than 5% cover using the aquatic herbicide Diquat to allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.

- 8) In 2007 and 2008, eliminate pioneering patches of variable milfoil growth from individual points using hand removal, benthic barriers, and/or diver assisted suction harvesting.
- 9) The longer term goal is to maintain variable milfoil coverage to at or below the above referenced specifications for each area by using hand-removal, benthic barriers, and/or diver-assisted suction harvesting in summer 2007, and annually thereafter if new stems or localized patches are present in larger areas of infestation. Additional herbicide applications may be done at 3-year intervals if needed to prevent variable milfoil from exceeding these specified levels.
- 10) In 2009, seek the approval through the NH Department of Agriculture, Markets and Food, Division of Pesticide Control to conduct a 2010 herbicide treatment of Lake Monomonac using the aquatic herbicide, Renovate, to control variable milfoil by targeting the rooting systems of the plant. This application will be researched during 2007, and will be based on findings from the experimental use of Renovate at two sites in Lake Winnepesaukee (Suissevale and Mountain View Yacht Club), and based on an August or September 2009 survey of Lake Monomonac to determine post-Diquat treatment populations of variable milfoil. This 2010 project would seek to provide more effective and longer-term control of variable milfoil by using an aquatic herbicide (other than 2,4-D) that is systemic in its mode of action.

#### Town Support

The town has made no financial allocations towards variable milfoil control or other related activities at the lake. Most activities are funded wholly by the lake association.

#### Lake Monomonac Lake Association Support

The Lake Association is strongly behind controlling growths of variable milfoil in Lake Monomonac. Lake residents already participate in the Weed Watcher Program and assist with hand-removal as needed. The lake also has an active Lake Host Program during the summer months, and they also monitor water quality of the lake.

#### **WATERBODY CHARACTERISTICS**

The following table summarizes basic physical and biological characteristics of Lake Monomonac.

<b>General Lake Information</b>	
Lake area (acres)	711.1
Watershed area (acres)	12,488.4
Shoreline Uses (residential, forested, agriculture)	Residential, forested
Max Depth (m)	7.8
Mean Depth (m)	2.8
Trophic Status	Mesotrophic
Color (CPU) in Epilimnion	45

pH (Epilimnion/Metalimnion/Hypolimnion)	
Clarity (m)	2.7
Flushing Rate (yr <sup>-1</sup> )	3.60
Natural waterbody/Raised by Damming/Other	Raised by damming
<b>Plant Community Information Relative to Management</b>	
Invasive Plants (Latin name)	<i>Myriophyllum heterophyllum</i>
Infested Area on NH Side (acres)	13.2
Distribution (ringing lake, patchy growth, etc)	Isolated patches along shorelines and within small coves in New Hampshire portion of lake.
Sediment type in infested area (sand/silt/organic/rock)	Silty/organic/rock
Rare, Threatened, or Endangered Species in Waterbody (based on NH Natural Heritage Bureau database)	None on record
Area of Littoral Zone (acres)	321.2
Area of Profundal Zone (acres)	272.9
Area of Macrophyte Coverage (native or otherwise) of Plants in Littoral Zone	41.8
% of Littoral Zone with Macrophyte Cover on NH side	13%
% of Macrophyte cover comprised of invasives on NH side	32%
% of Littoral Zone with Variable Milfoil Cover on NH side	4%

An aquatic vegetation map and key from a summer 2006 survey by the DES Biology Section is shown in Figure 1. A bathymetric map is shown in Figure 2.

### **BENEFICIAL (DESIGNATED) USES**

In New Hampshire, beneficial (designated) uses of our waterbodies are categorized into five general categories: Aquatic Life, Fish Consumption, Recreation, Drinking Water Supply, and Wildlife (CALM).

Of these, Aquatic Life and Recreation are the two affected by the presence of variable milfoil.

### **AQUATIC LIFE**

The goal for aquatic life support is to provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of the region.

## **FISHERIES AND WILDLIFE**

Lake Monomonac is managed as a warmwater fishery and was surveyed on July 12, 2005. Largemouth and small mouth bass are the primary gamefish present. Largemouth bass growth was categorized as fast when compared to fish from New Hampshire waterbodies sampled during 1997-2005. Average length at age was above statewide values (1997-2005) for all ages of largemouth bass from age 1-5.

Other species present include yellow perch, chain pickerel, golden shiner, pumpkinseed, white perch, creek chubsucker, brown and yellow bullhead, and black crappie.

The local Conservation Officer reports boat traffic to be extremely heavy, angling pressure is relatively light and anglers are generally pleased with their fishing success. A good number of bass tournaments are held on the lake each year and the lake is a popular destination for open water and ice anglers.

Figure 3 shows the approximated common fishing areas, as indicated by lake residents.

## **RECREATION USES AND ACCESS POINTS**

Lake Monomonac is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both lake residents and transient boaters. Figure 4 illustrates key elements of the pond and watershed that may be of interest in this evaluation. There is a public boat access site on the southern end of the lake just off Route 202 as one enters the State of Massachusetts. There are private wells scattered along the shoreline of the lake.

There is a public (also called “designated”) beach on the lake, located approximately half way down the eastern shoreline. A designated beach is described in the CALM as an area on a waterbody that is operated for bathing, swimming, or other primary water contact by any municipality, governmental subdivision, public or private corporation, partnership, association, or educational institution, open to the public, members, guests, or students whether on a fee or free basis. Env-Wq 1102.14 further defines a designated beach as *“a public bathing place that comprises an area on a water body and associated buildings and equipment, intended or used for bathing, swimming, or other primary water contact purposes. The term includes, but is not limited to, beaches or other swimming areas at hotels, motels, health facilities, water parks, condominium complexes, apartment complexes, youth recreation camps, public parks, and recreational campgrounds or camping parks as defined in RSA 216-I:1, VII. The term does not include any area on a water body which serves 3 or fewer living units and which is used only by the residents of the living units and their guests.”*

Roughly 10-20 people use the town beach during summer weekends. No data exist for weekday use at either beach.

Figure 5 shows the locations commonly used for swimming, and the locations of docks on Lake Monomonac. The tan colored polygons shows locations where people generally use their waterfront areas and has private beach areas for swimming, and the red points show locations docks.

Figure 6 shows an approximation of the boating lanes on the lake. Pleasure boating by most watercraft takes place in the deeper portions of Lake Monomonac, as indicated by the boat paths in this figure. Fishermen and non-motorized craft are often found close to shore, as well.

### **MACROPHYTE EVALUATION**

The littoral zone is defined as the nearshore areas of a waterbody where sunlight penetrates to the bottom sediments. The littoral zone is typically the zone of rooted macrophyte growth in a waterbody. The littoral zone of Lake Monomonac is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2). Native species include a mix of floating plants (watershield, yellow water-lily, white water-lily), emergent plants (three-way sedge, pickerelweed, cattail, bur-reed), and submergent plants (pondweeds, native milfoil, bladderwort). Native plant communities are comprised of a mix of various species and are distributed around the entire littoral zone of the lake.

### **HISTORICAL CONTROL ACTIVITIES ON LAKE MONOMONAC**

<b>Contractor</b>	<b>Management Type</b>	<b>Cost</b>	<b>Treatment Date</b>	<b>Treatment Acres</b>	<b>Effectiveness</b>
ACT	Diquat	\$4,950	6/8/99	4	Contained infestation at this level
ACT	Diquat	\$5,880	6/14/00	8 (4 in Coot Bay and 4 in Marina)	Contained infestation at this level
ACT	Diquat	\$4,480	6/6/01	8	Contained infestation at this level
ACT	Diquat	\$3,725	6/25/02	8	Contained infestation at this level
ACT	Diquat		6/17/03	8	Contained infestation at this level
Lycott	Diquat	\$3,500	6/9/04	8	Contained infestation at this level
ACT	Diquat	\$4,795	6/14/05	10	Contained infestation at this level

### **MILFOIL MANAGEMENT OPTIONS**

The control practices used should be as specific to variable milfoil as feasible.

Exotic aquatic plant management relies on a combination of proven methods that control exotic plant infestations, including physical control, chemical control, biological controls (where they exist), and habitat manipulation. Integrated Pest Management Strategies (IPM) are typically

implemented using Best Management Practices (BMPs) based on site-specific conditions so as to maximize the long-term effectiveness of control strategies. Descriptions for the control activities are closely modeled after those prescribed by the Aquatic Ecosystem Restoration Foundation (AERF) (2004). This publication can be found online at [http://www.aquatics.org/aquatic\\_bmp.pdf](http://www.aquatics.org/aquatic_bmp.pdf).

Criteria for the selection of control techniques are presented in Appendix A. Appendix B includes a summary of the exotic aquatic plant control practices used by the State of New Hampshire. DES has evaluated the feasibility of potential control practices in Lake Monomonac. The following table summarizes DES' control strategy recommendations for Lake Monomonac.

#### FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

<b>Control Method</b>	<b>Use on Lake Monomonac</b>
Restricted Use Areas	Not recommended as variable milfoil patches are too widely distributed throughout pond
Hand-pulling	DES recommends that the individual stems or small patches of variable milfoil.  DES also recommends that the lake residents follow up the herbicide application with hand-pulling of re-growth, if that re-growth is small and scattered.
Mechanical Harvesting/Removal	For Lake Monomonac, mechanical harvesting is not recommended due to the threat of spreading variable milfoil to uninfested areas of the lake through the generation of fragments.
Benthic Barriers	For Lake Monomonac, DES recommends installing small benthic barriers in areas of re-growth if small patches of variable milfoil re-grow and can adequately be contained by benthic barriers. We do not recommend installing benthic barriers throughout the lake, however.
Herbicides	We recommend that the herbicide be used to reduce overall densities of variable milfoil, and to help maintain variable milfoil levels in Lake Monomonac, a technique that has worked well in the past.  A Renovate treatment is recommended in 2010 to treat areas of variable milfoil growth in the Lake Monomonac system. Renovate is a systemic herbicide with target specificity for variable milfoil, and because it affects the rooting systems of the plants, it can provide longer term control where Diquat generally does not. The herbicide 2,4-D has not historically been permitted at Lake Monomonac due to the locations of numerous wells and intakes. Renovate does not have the same setback restrictions as 2,4-D, and may be a viable option for this lake, pending 2007 field trial data from other locations in NH.
Extended Drawdown	For Lake Monomonac, this is not a recommended or feasible strategy.
Dredge	Not recommended due to nature of exotic plant distribution, and the fact the variable milfoil quickly colonizes dredged areas.
Biological Control	There are no approved biological controls for variable milfoil at this time in New Hampshire.

No Control	In order to allow for a healthy stand of mixed native aquatic vegetation, as well as areas of bare substrate in the shallows, a 'No Control' option is not recommended. Without control, variable milfoil will eventually take over 100% of the littoral zone of Lake Monomonac.
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### **EXOTIC AQUATIC PLANT CONTROL PLAN**

An evaluation of the size, location, and type of variable milfoil infestation, as well as the waterbody uses was conducted by DES during October 2006. Based on the evaluation, the following control actions are recommended for Lake Monomonac:

<b>Year</b>	<b>Treatment Type</b>	<b>Responsible Party</b>	<b>Schedule</b>
2007	Diquat treatment of Areas 1, 4, 5, 5a, 6, and 7.	Aquatic Control Technology, Inc.	May/June
	Hand remove/suction harvest/benthic barrier variable milfoil growth at any individual points, including Area 2 and Area 3.	Lake residents and/or licensed contractor	June/July
	Continue Lake Host Program at public access site	Lake Association	June through August
	Perform Weed Watcher activities	Lake Association	Monthly during summer months
2008	Hand remove/suction harvest/benthic barrier variable milfoil growth at any individual points	Lake residents and/or licensed contractor	June/July
	Continue Lake Host Program at public access site	Lake Association	June through August
	Perform Weed Watcher activities	Lake Association	Monthly during summer months
2009	Evaluate the status of variable milfoil growth and native plant growth and determine need for 2010 herbicide treatment using Diquat or Renovate. Contract if/as appropriate.	NH DES	August
	Hand remove/suction harvest/benthic barrier variable milfoil growth at any individual points	Lake residents and/or licensed contractor	June/July
	Continue Lake Host Program at public access site	Lake Association	June through August
	Perform Weed Watcher activities	Lake Association	Monthly during summer months
2010	Perform herbicide treatment if needed (as determined by DES Limnologists if milfoil percent cover exceeds recommended levels.	Licensed Contractor	May/June

	Hand remove/suction harvest/benthic barrier variable milfoil growth at any individual points	Lake residents and/or licensed contractor	June/July
	Continue Lake Host Program at public access site	Lake Association	June through August
	Perform Weed Watcher activities	Lake Association	Monthly during summer months
2011	Hand remove/suction harvest/benthic barrier variable milfoil growth at any individual points	Lake residents and/or licensed contractor	June/July
	Continue Lake Host Program at public access site	Lake Association	June through August
	Perform Weed Watcher activities	Lake Association	Monthly during summer months
2012	Update and revise Long-Term Variable Milfoil Control Plan	NH DES, F&G, and interested parties	Spring 2012

The herbicide application will be targeted to the specific areas of milfoil growth shown in Figure 1. Only areas with milfoil growth will be targeted for control activities. Approximately 18% of this 74 acre lake is slated for herbicide treatment, based on the locations of variable milfoil growth mapped in 2006.

### **CONSIDERATIONS FOR SELECTED MANAGEMENT PRACTICE**

- Less than 13 acres of the waterbody will be impacted by the herbicide treatment (approximately 2% of the overall surface area). Targeted applications can be achieved by boat. Herbicide applications on the Massachusetts side of the lake are not set for 2007.
- The Department of Agriculture will impose standard short-term use restrictions for specified days depending on the use (irrigation, contact, etc) and the herbicide used. The shoreline will be posted and public notice will be made.
- By recommending follow-up management practices that utilize integrated plant management strategies such as benthic barrier placement and hand-pulling re-growth, variable milfoil re-growth or population expansion can be slowed and contained.
- Based on the types of native plants that are mixed in with the stands of variable milfoil (Figure 2) where herbicide application is recommended there are no expected significant impacts to native plant communities. It is expected that a well distributed stand of native aquatic plants will remain following herbicide application. This is a large lake system, and many areas of the lake can serve as good fish and wildlife habitat during the treatment of the small coves.
- The proposed treatment areas are very small and localized on this large lake, and as such, there will be more than 98% of the lake that does not receive an herbicide treatment. There is ample habitat for fish and wildlife throughout the balance of the lake that will not receive

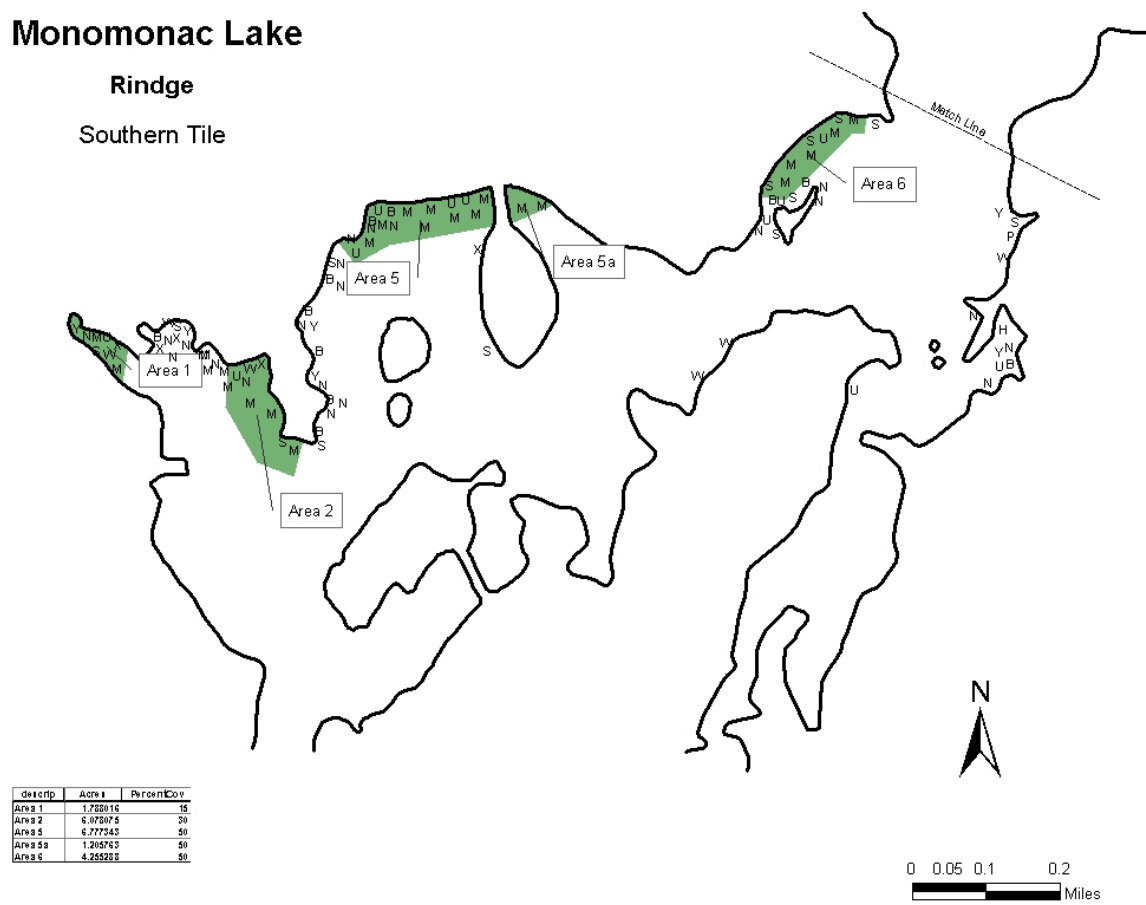
an herbicide application. Additionally, only short segments of shoreline will receive treatment, so impacts to spawning habitats will be minimized.

**Figure 1a- Map of Milfoil Infestation in Lake Monomonac**

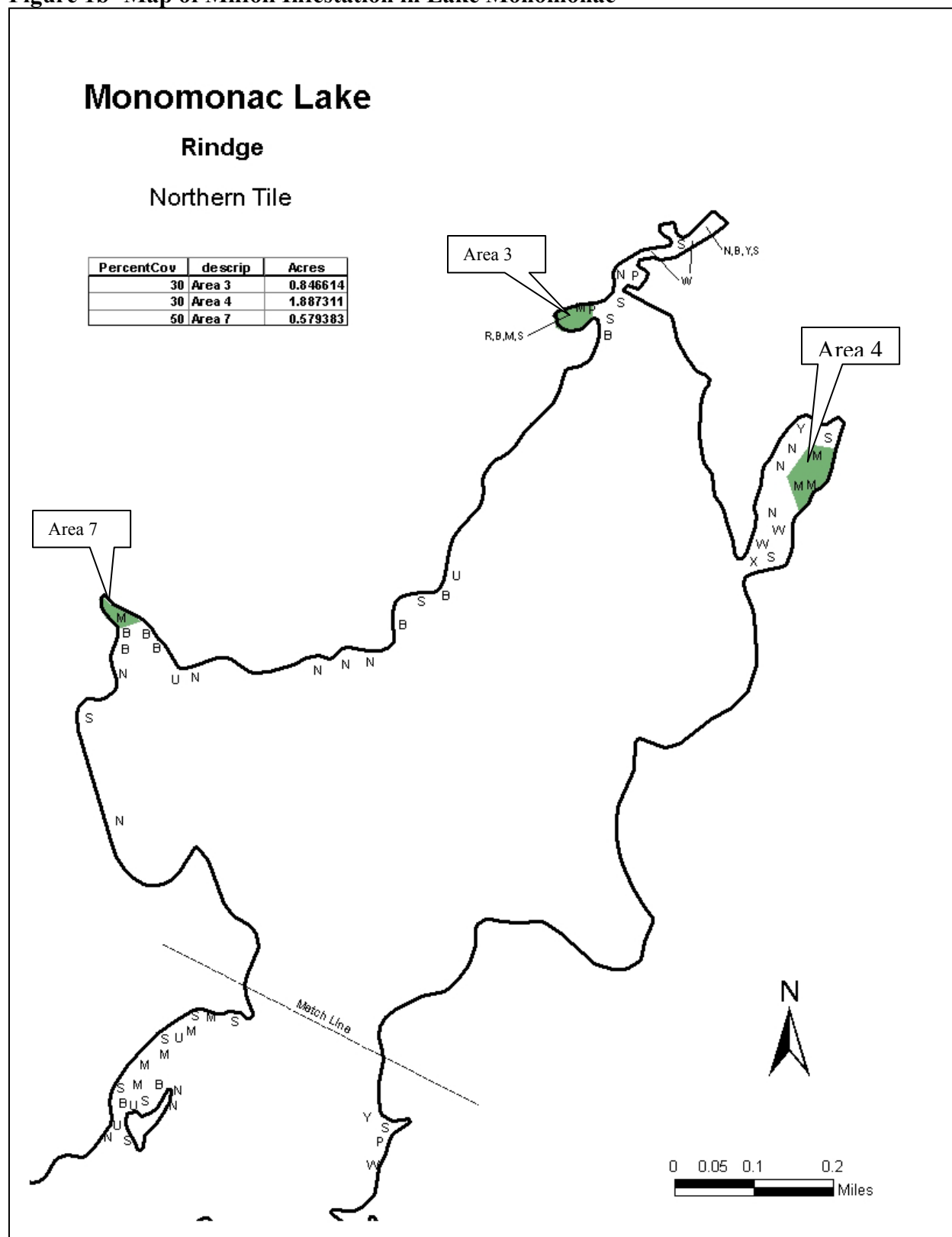
## Monomonac Lake

Rindge

Southern Tile

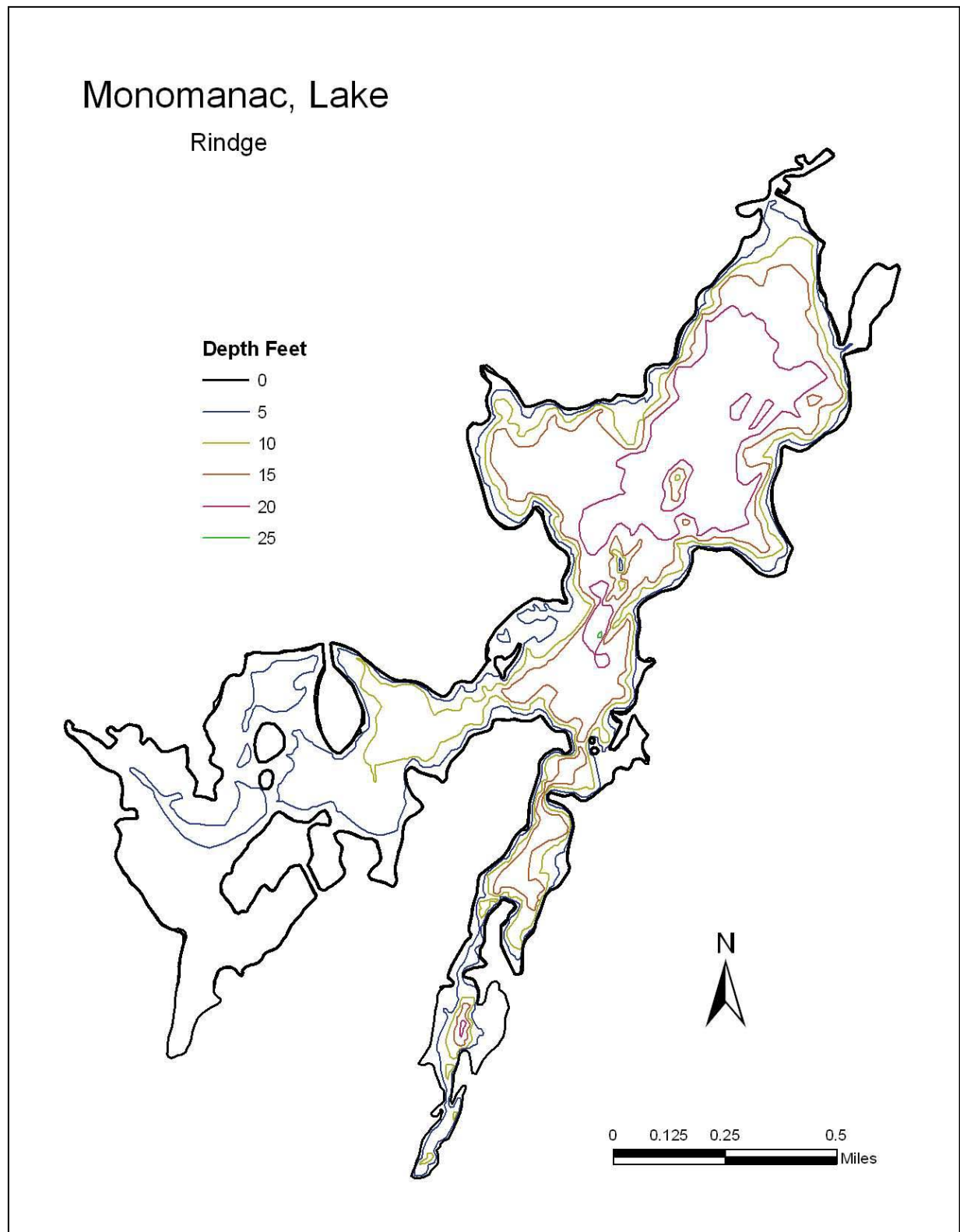


**Figure 1b- Map of Milfoil Infestation in Lake Monomonac**

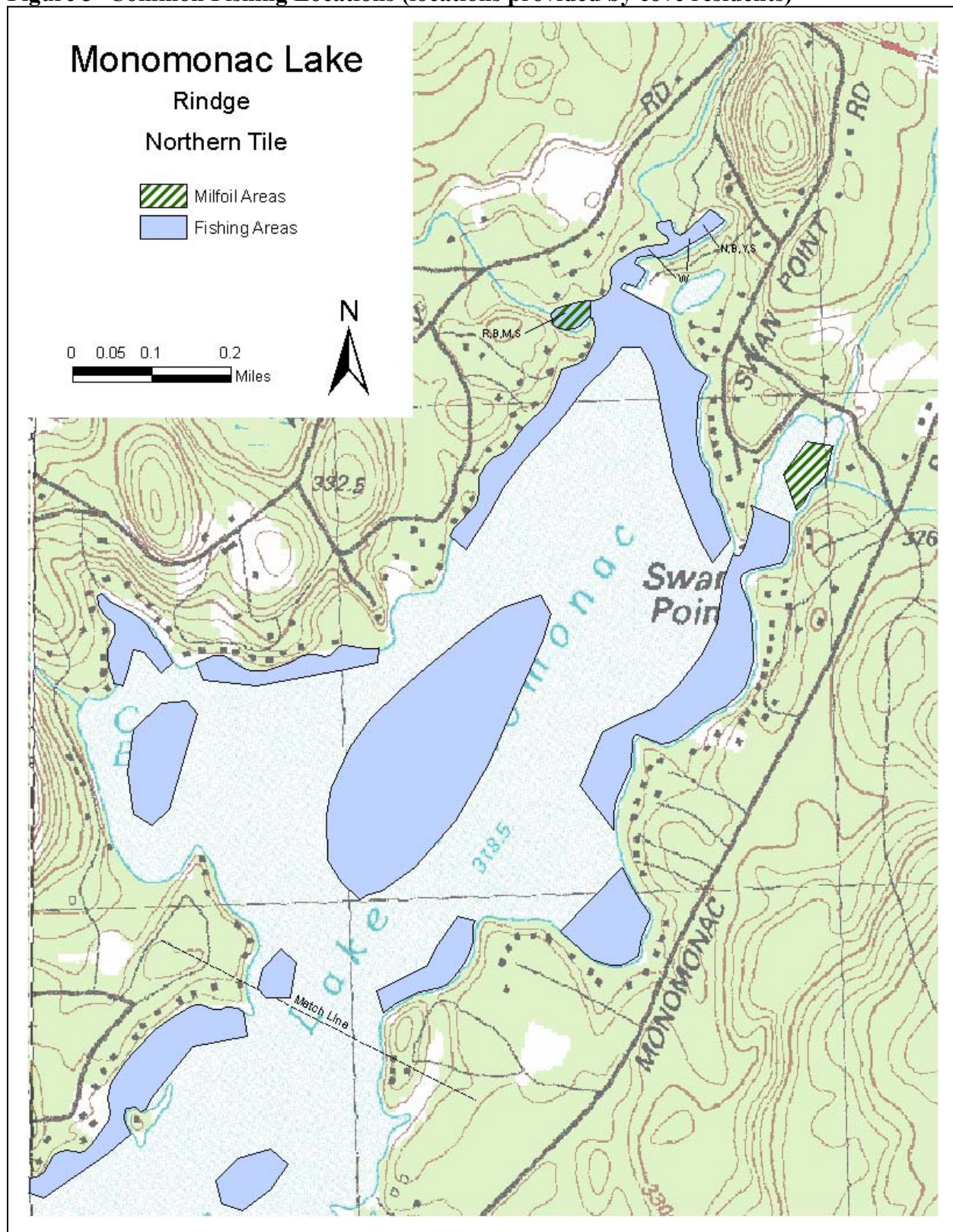


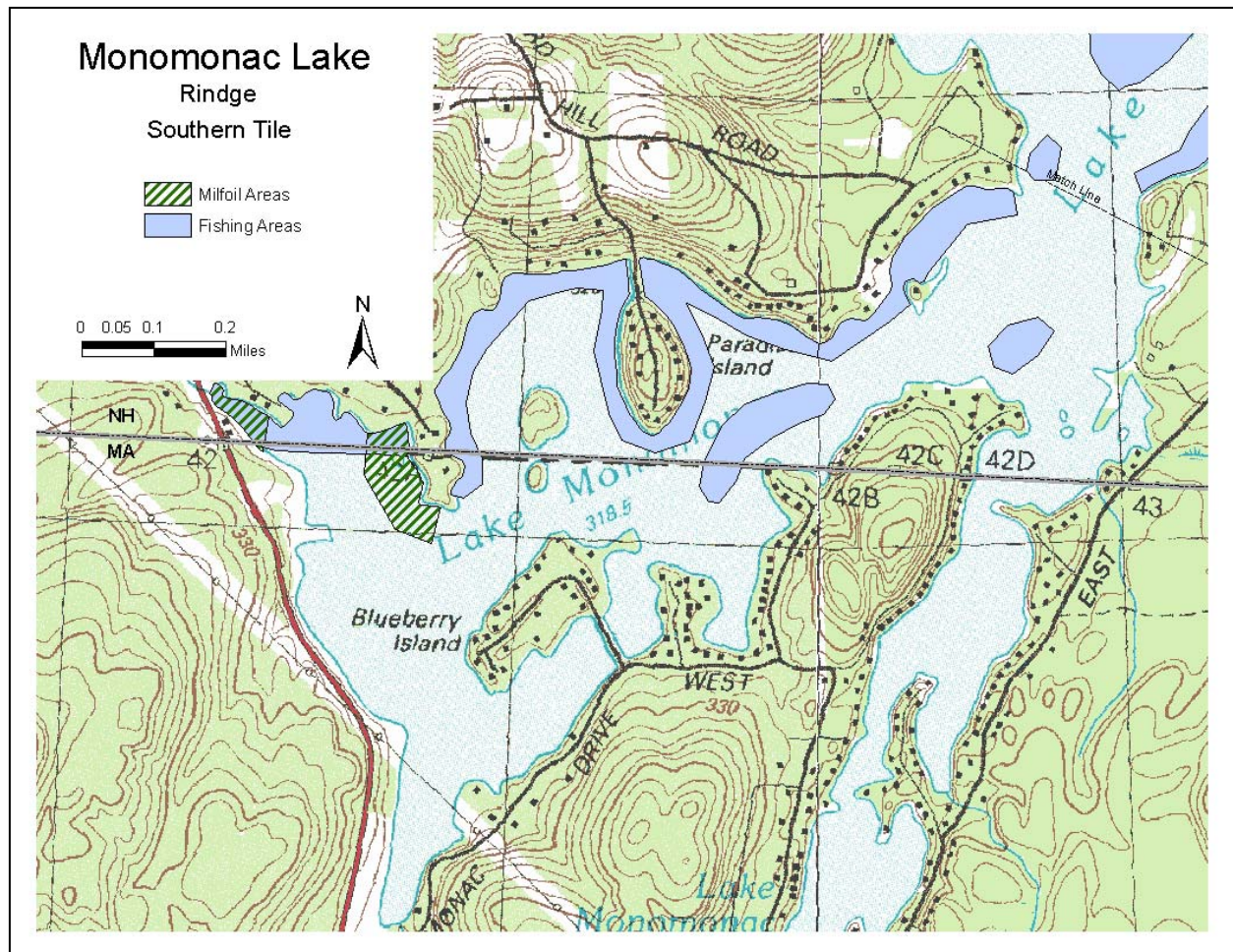
<b>Symbol</b>	<b>Common Name</b>	<b>Latin Name</b>
H	Native milfoil	<i>Myriophyllum humile</i>
d	Three-way sedge	<i>Dulichium arundinaceum</i>
P	Pickerelweed	<i>Pontedaria cordata</i>
T	Cattail	<i>Typha</i>
B	Watershield	<i>Brasenia</i>
N	White water-lily	<i>Nymphaea</i>
Y	Yellow water-lily	<i>Nuphar</i>
S	Bur-reed	<i>Sparganium</i>
U	Bladderwort	<i>Utricularia</i>
X	Bottom growth	<i>Likely Eleocharis spp.</i>
W	Pondweed	<i>Potamogeton</i>
<b>M</b>	<b>Variable milfoil</b>	<b><i>Myriophyllum heterophyllum</i></b>

**Figure 2- Bathymetric Map**



**Figure 3- Common Fishing Locations (locations provided by cove residents)**





**Figure 4- Public Uses and Access Points**

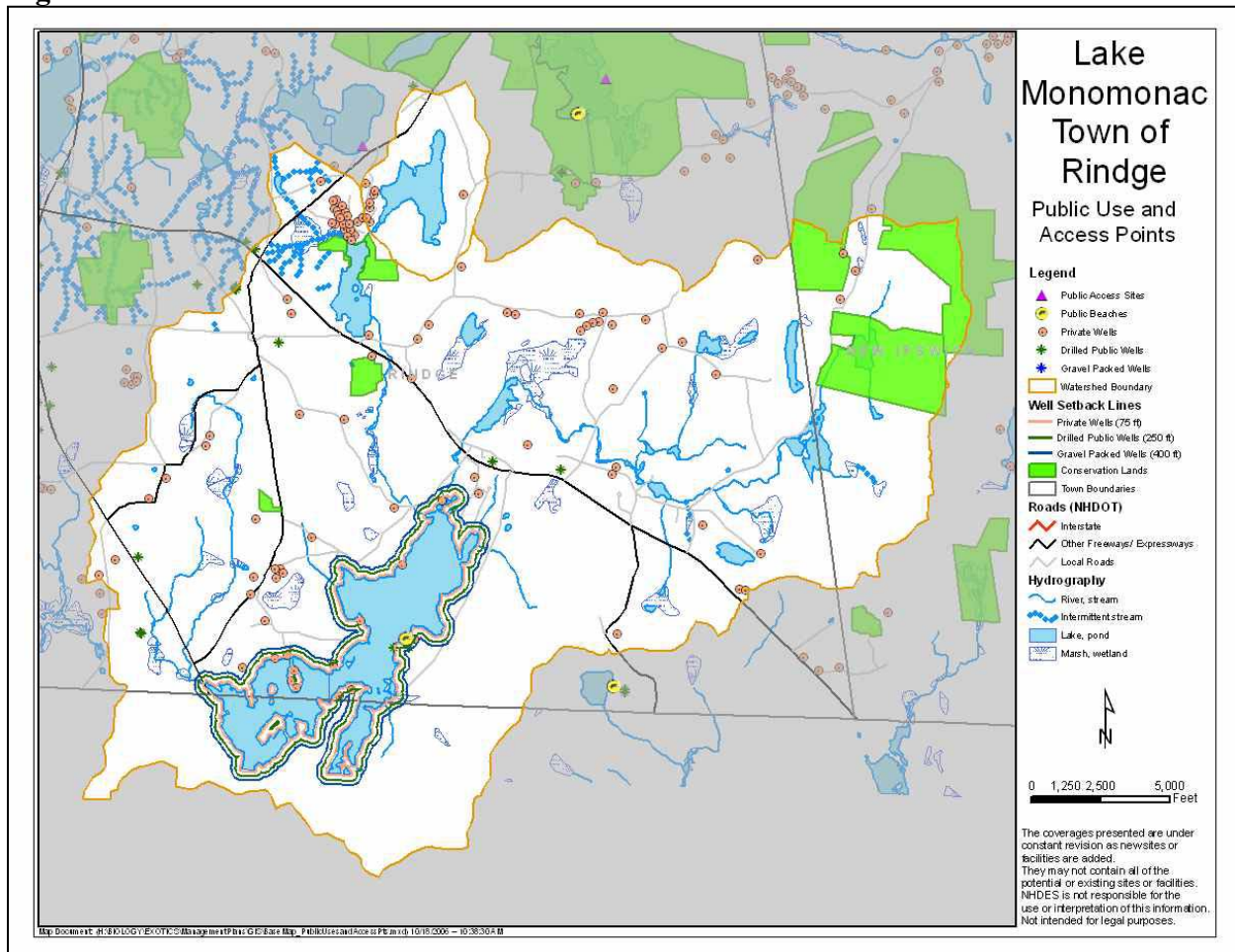
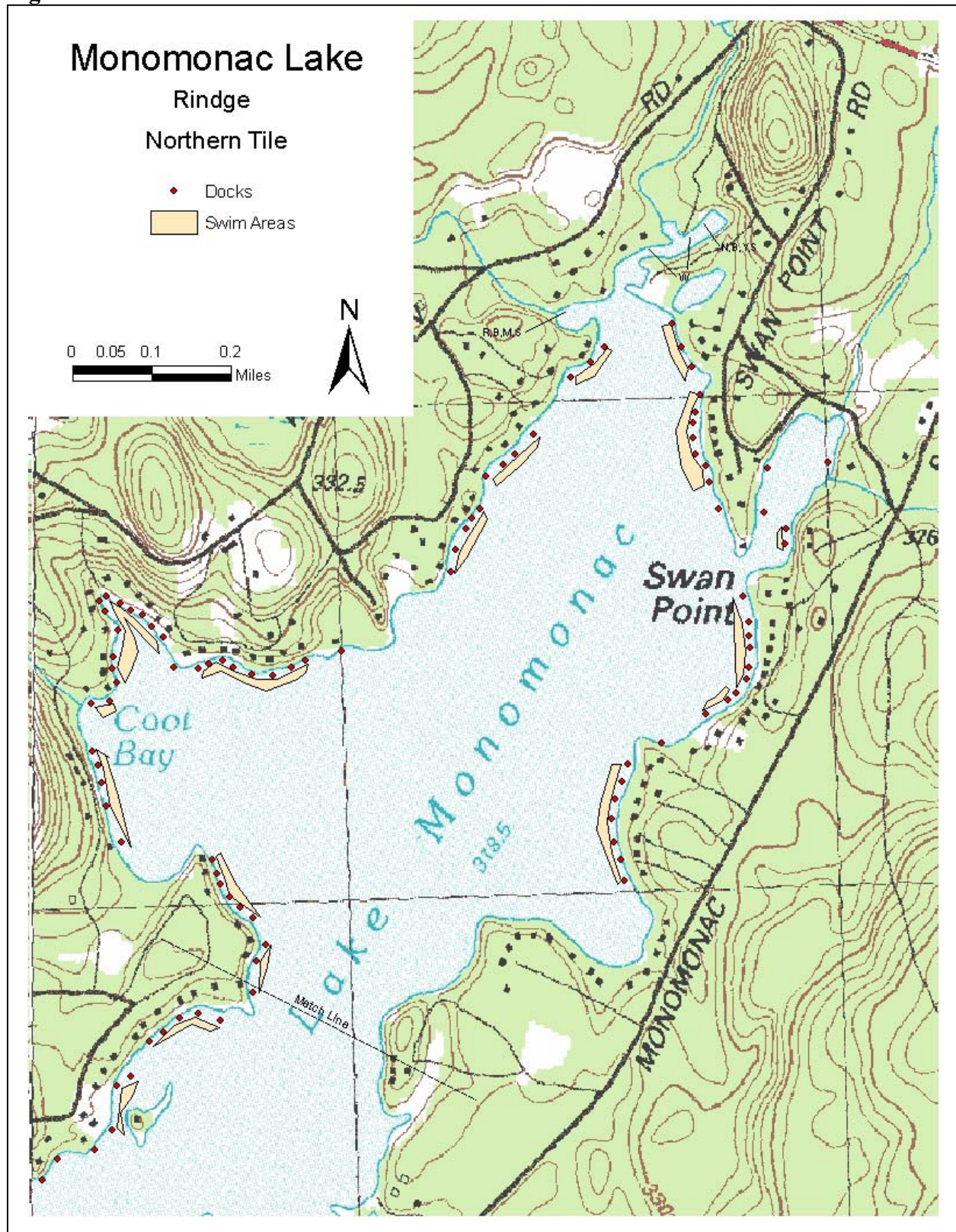


Figure 5- Swim Areas and Docks



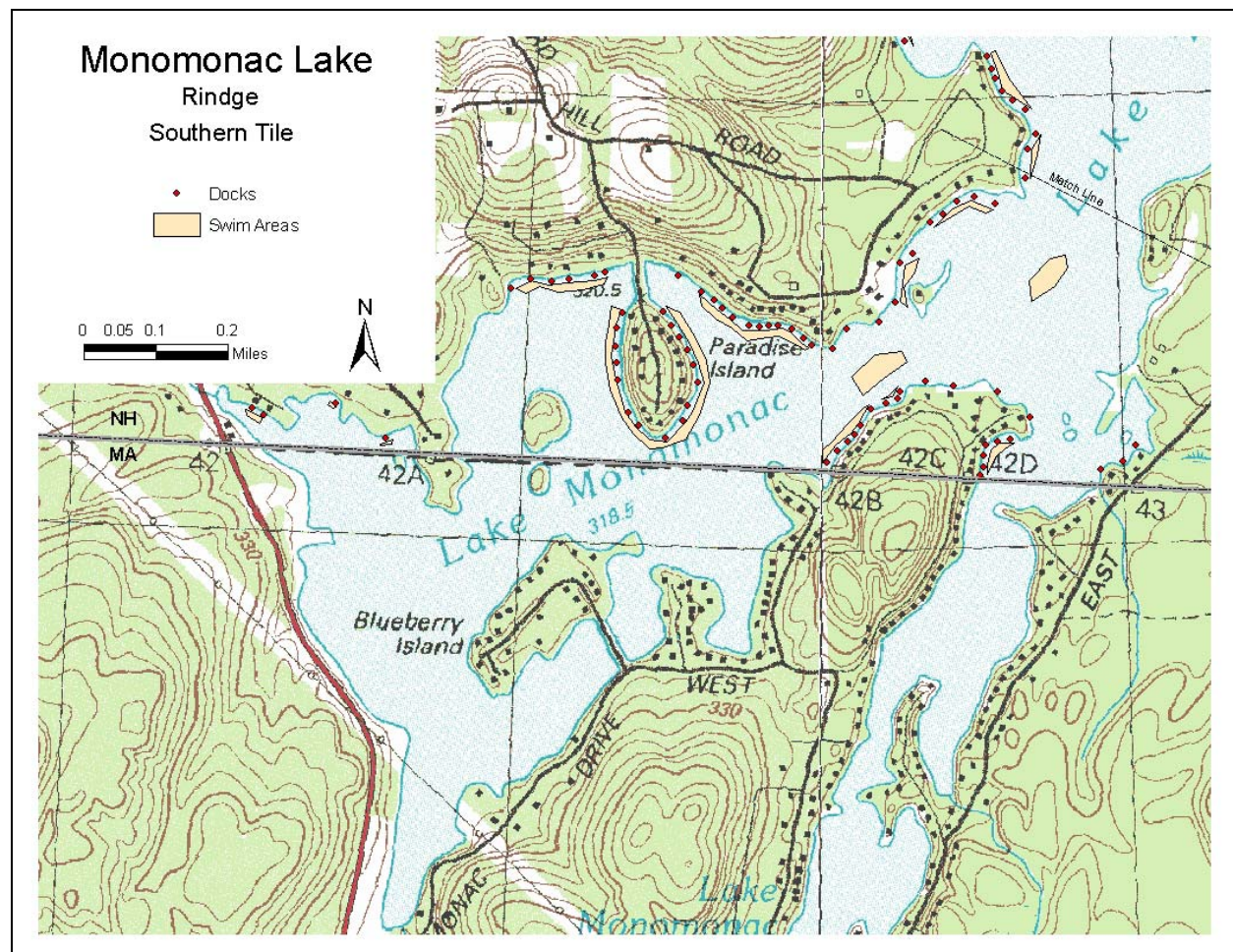
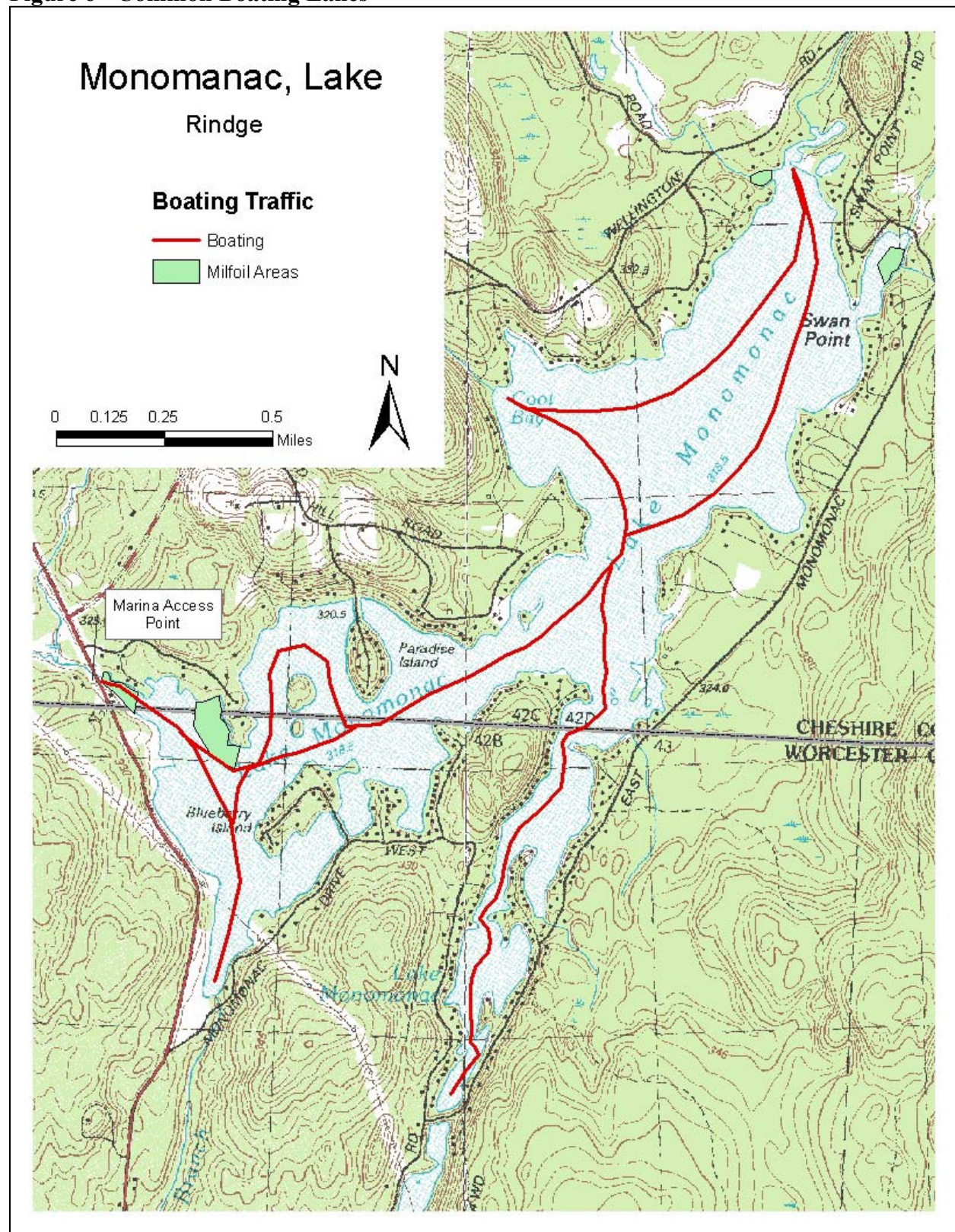


Figure 6- Common Boating Lanes



## **APPENDIX A**

### **Criteria to Evaluate the Selection of Aquatic Plant Control Techniques**

NH Department of Environmental Services

Water Division

Preliminary Investigations

#### **I. Field Site Inspection**

- Verify genus and species of the plant.
- Determine if the plant is a native or exotic species per RSA 487:16, II.
- Map extent of the plant infestation (area, water depth, height of the plant, density of the population).
- Document any native plant abundances and community structure around and dispersed within the exotic/nuisance plant population.

#### **II. Office/Laboratory Research of Waterbody Characteristics**

- Contact the appropriate agencies to determine the presence of rare or endangered species in the waterbody or its prime wetlands.
- Determine the basic relevant limnological characteristics of the waterbody (size, bathymetry, flushing rate, nutrient levels, trophic status, and type and extent of adjacent wetlands).
- Determine the potential impacts to downstream waterbodies based on limnological characteristics (water chemistry, quantity, quality).

### **Overall Control Options**

For any given waterbody that has an infestation of exotic plants, one of three options will be selected, based on the status of the infestation, the available management options, and the technical knowledge of the DES Limnologists who have conducted the field work and who are preparing this plan. The options are as follows:

- 1) **Eradication:** Herbicide application targeted at exotic aquatic plant to be eradicated, to either eradicate the plant or to reduce overall biomass to a point where alternative non-chemical strategies may be used. This action will be followed by thorough annual monitoring for regrowth and the use of non-chemical actions to achieve the eradication.
- 2) **Containment:** The aim of this approach is to limit the size and extent of the existing infestation. An herbicide application may be used to reduce specified areas down to a percent cover of the exotic species so that it can be maintain or contained with alternative management strategies, including Restricted Use Areas, benthic barriers, and others. Subsequent herbicide applications may be necessary if the target species shows exponential growth and further spread.

- 3) No action. If the infestation is too large, spreading too quickly, and past management strategies have proven ineffective at controlling the target exotic aquatic plant, DES, in consultation with others, may elect to recommend 'no action' at a particular site. All efforts will instead be made towards containment of the target species to that specific waterbody, so that downstream migration of the plant can be prevented.

If eradication or control is the recommended option to pursue, the following series of control techniques may be employed. The most appropriate technique based on the determinations of the preliminary investigation will be selected.

Guidelines and requirements of each control practice are detailed below each alternative.

**A. Hand-Pulling**

- Can be used for exotic or native species.
- Can be used if infestation is in a small localized area (sparsely populated patch of up to 5' X 5', single stems, or dense small patch up to 2' X 2').
- Can be used if plant density is low, or if target plant is scattered and not dense.
- Can be used if the plant could effectively be managed or eradicated by hand-pulling a few scattered plants.
- Use must be in compliance with the Wetlands Bureau rules.

**B. Mechanically Harvest or Hydro-Rake**

- Can not be used on plants which reproduce vegetatively by fragmentation (e.g., milfoil, fanwort, etc.) unless containment can be ensured.
- Can be used only if the waterbody is accessible to machinery.
- Can be used if there is a disposal location available for harvested plant materials.
- Can be used if plant depth is conducive to harvesting capabilities (~ <7 ft. for mower, ~ <12 ft. for hydro-rake).
- Funds are available for repeated harvesting activities in that season.
- A navigation channel is required through dense plant growth.

**C. Chemical Treatment**

- Can be used if application of chemical is conducted in areas where alternative control techniques are not optimum due to depth, current, use, or type of plant.
- Can be used for treatment of exotic plants where fragmentation is a high concern.
- Can be used where species specific treatment is necessary due to the need to manage other plants (rare or endangered that will not be impacted by chemical treatment).
- Can be used if other methods used as first choices in the past have not been effective.
- A licensed applicator should be contacted to inspect the site and make recommendations about the effectiveness of chemical treatment as compared with

other treatments.

**D. Restricted Use Areas (per RSA 487:17, II (d))**

- Can be used for exotic species only.
- Can be established in an area that effectively restricts use to a small cove, bay, or other such area where navigation, fishing, and other activities may cause fragmentation to occur.
- Can not be used when there are several “patches” of an infestation of exotic aquatic plants throughout a waterbody.
- Can be used as a temporary means of control.

**E. Bottom Barrier**

- Can be used for exotic or native species.
- Can be used in small areas, preferably less than 10,000 sq. ft.
- Can be used in an area where the current is not likely to cause the displacement of the barrier.
- Can be used early in the season before the plant reaches the surface of the water.
- Can be used in an area to compress plants to allow for clear passage of boat traffic.
- Can be used in an area to compress plants to allow for a clear swimming area.

**F. Drawdown**

- Can be used if the target plant(s) are susceptible to drawdown control.
- Can be used in an area where bathymetry of the waterbody would be conducive to an adequate level of drawdown to control plant growth, but where extensive deep habits exist for the maintenance of aquatic life such as fish and amphibians.
- Can be used where plants are growing exclusively in shallow waters where a drawdown would leave this area “in the dry” for a suitable period of time (over winter months) to control plant growth.
- Can be used in winter months to avoid encroachment of terrestrial plants into the aquatic system.
- Can be used if it will not significantly impact adjacent or downstream wetland habitats.
- Can be used if spring recharge is sufficient to refill the lake in the spring.
- Can be used in an area where shallow wells would not be significantly impacted.
- Reference RSA211:11 with regards to drawdown statutes.

**G. Dredge**

- Can be used in conjunction with a scheduled drawdown.
- Can be used if a drawdown is not scheduled, though a hydraulic pumping dredge should be used.

- Can only be used as a last alternative due to the detrimental impacts to environmental and aesthetic values of the waterbody.

## **H. Biological Control**

- Grass carp cannot be used.
- Exotic controls, such as insects, cannot be introduced to control a nuisance plant.
- Research should be conducted on a potential biological control prior to use to determine the extent of host specificity.

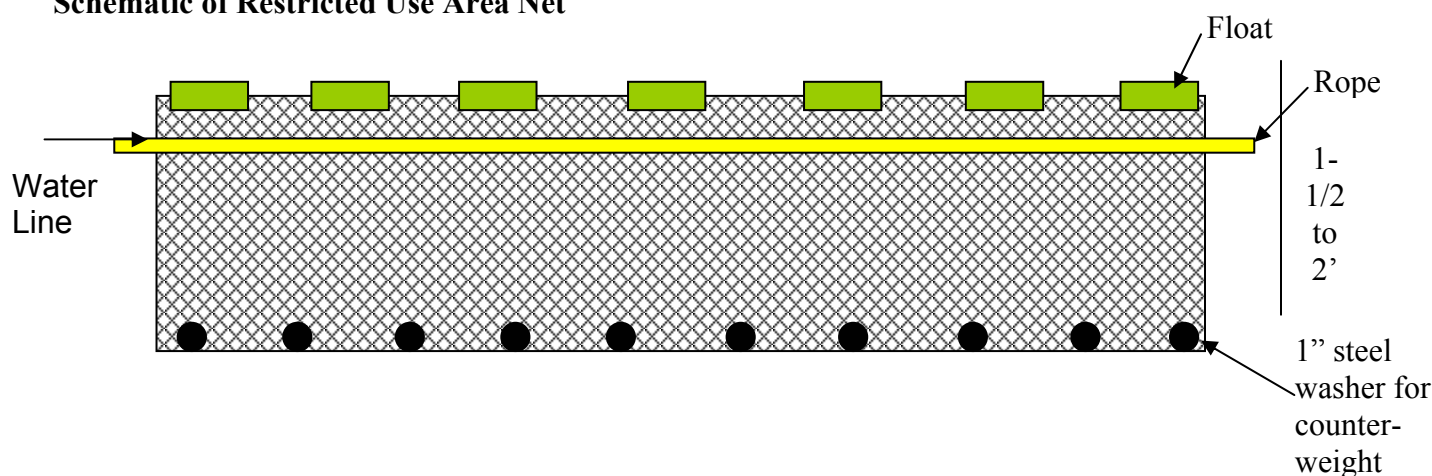
## APPENDIX B

### SUMMARY OF CONTROL PRACTICES USED IN THE STATE OF NEW HAMPSHIRE FOR EXOTIC AQUATIC PLANTS

#### **Restricted Use Areas:**

Restricted Use Areas (RUAs) are a regular control option for lakes with small, contained infestations of exotic plants, limited to small patches or embayments. This is often the case in waterbodies with newly-discovered infestations. RUAs restrict access to all recreational activities in a delineated area to minimize plant fragmentation and thereby reduce the spread of milfoil. As an additional method of protection from fragment migration, RUAs are encircled with a shallow net that is suspended vertically in the water column. The net is approximately 1.5-2.0 feet in height. The top of the net is set to extend four inches above the surface of the water, while the remainder is positioned below the surface of the water (see figure below). This configuration prevents the movement of fragments from infested areas to uninfested areas. Due to the size and nature of net construction, there is no impediment to fish migratory patterns or spawning activities.

#### **Schematic of Restricted Use Area Net**



#### **Hand-pulling:**

When infestations of exotic aquatic plants begin as single scattered stems or small patches, DES biologists SCUBA dive to hand-pull the plants (and DES can train other certified divers to also perform this management practice). Guidelines for determining feasibility and effective for hand-removal are site specific, but generally sparsely populated patches of up to 5' X 5', single stems, or dense small patch up to 2' X 2' are reasonable.

The whole plant including the roots should be removed in this process, while leaving the beneficial native species intact. This technique works best in softer sediments, with shallow rooted species and for smaller, scattered infestation areas. When hand pulling nuisance species, the entire root system and all fragments of the plants must be collected since small root or stem fragments could result in additional growth of the species. The process must be repeated often to control re-growth of the exotic plants. For a new infestation, hand-pulling activities are typically conducted several times during the first season, with follow-up inspections for the next 2-5 years

or until no re-growth is observed. This control practice has proven successful in many waterbodies.

### **Mechanical Harvesting**

The process of mechanical harvesting is conducted by using machines which cut and collect aquatic plants. These machines can cut the plants up to twelve feet below the water surface. The weeds are cut and then collected by the harvester or other separate conveyer-belt driven device where they are stored in the harvester or barge, and then transferred to an upland site.

The advantages of this type of weed control are that cutting and harvesting immediately opens an area such as boat lanes, and it removes the upper portion of the plants. Due to the size of the equipment, mechanical harvesting is limited to water areas of sufficient size and depth. It is important to remember that mechanical harvesting can leave plant fragments in the water, which if not collected, may spread the plant to new areas. Additionally harvesters may impact fish and insect populations in the area by removing them in harvested material. Cutting plant stems too close to the bottom can result in re-suspension of bottom sediments and nutrients. This management option is only recommended when nearly the entire waterbody is infested, and harvesting is needed to open navigation channels through the infested areas.

### **Benthic Barriers:**

When a small infestation of exotic aquatic plants occurs in clusters of growth (generally areas  $>5 \text{ ft}^2$ ), as opposed to scattered stems, a permeable fiberglass screen can be placed over the area of infested lake sediments. The permeable fabric screening allows for gas release from the sediments while effectively blocking sunlight and compressing the plants into the sediment, inhibiting photosynthesis and eventually killing the plant. Occasionally, in some lakes, gas release from the sediments or boating activity cause the uplifting of screening. Benthic barriers can effectively control small infestations of less than approximately 10,000 square feet.

Benthic barriers have two basic applications. These practices are used to cover pioneering infestations and prevent the spread of the plant. Bottom barriers are installed across small portions of lake bottoms infested with invasive aquatic plants. The disadvantage of benthic barriers is their non-selectivity and limitation of cover to less than 10,000 square feet. Additionally, these physical barriers prevent the growth of all vegetation, which is a necessary component of fish and wildlife habitat.

Bottom barriers are attached to the bottom of a water body by re-bar attached to the edges and across the middle of the material. Bottom barriers are transported to the shoreline adjacent to where installation is to occur. They are then cut to fit the treatment site and rolled onto a length of pipe. Divers carry the roll into the water at the start of the treatment site and secure one edge of the material to the lake bottom. The divers then roll out the remainder of the material and continue to secure it to the bottom sediments. This process is repeated until the plants in the treatment are covered.

Bottom barriers are generally considered for small localized areas rather than lakewide application. Bottom barriers provide 100% control of this weed in areas where they are installed. They also provide long-term control. An ongoing maintenance operation is required to inspect the bottom barrier and clear the mats of sediment buildup.

Benthic barriers are not recommended for application in river systems, as flow can easily uplift the barrier.

### **Targeted Application of Herbicides:**

The use of chemicals, such as herbicides, for the control of noxious and nuisance plant species represents one of the most widely known and effective management options available. Herbicide control of invasive aquatic plants is often the first step in a long-term integrated control program. In the last 15 to 20 years the use and review of herbicides has changed significantly in order to accommodate safety, health, and environmental concerns. Currently no herbicide product can be labeled for aquatic use if it has more than a one in a million chance of causing significant harmful effects to human health, wildlife, or the environment. Because of this, the number of effective and U.S. Environmental Protection Agency (EPA) approved herbicides for aquatic weeds are limited. In most cases the cost and time of testing and registration, rather than environmental issues, limits the number of potentially effective compounds.

All herbicide applications in New Hampshire are performed under permits issued by the New Hampshire Department of Agriculture, Division of Markets and Food, Bureau of Pesticide Control.

Two herbicides have been used in New Hampshire for the control of milfoil. Diquat (trade name Reward), the most often-used herbicide, is a contact herbicide that can generally provide one season of control for milfoil. Because this herbicide does not target the root systems, the plants eventually re-grow from established roots.

The second herbicide, 2, 4-D (trade name Navigate or Aqua Kleen), is a systemic herbicide. It is absorbed into the sediments and taken up through the root system, killing both the roots and the plant biomass above the sediments. Label restrictions for aquatic application currently limit its use in New Hampshire to waterbodies with no water intakes, and with no wells adjacent to the shoreline.

The aquatic herbicide SONAR has been used in New Hampshire to control growths of fanwort. The chemical acts by limiting photosynthesis when chlorophyll-a is affected by the active ingredient of the herbicide.

### **Extended Drawdown**

Water drawdown is used for control of some species of aquatic macrophytes. Drawdown requires some type of mechanism to lower water levels, such as dams or water control structures and use is thus limited. It is most effective when the drawdown depth exceeds the depth or invasion level of the target plant species.

In northern areas, drawdown will result in plant and root freezing during the winter for an added degree of control. Drawdown is typically inexpensive and has intermediate effects (2 or more years). However, drawdown can have other environmental effects and interfere with other functions of the water body (e.g. drinking water, recreation, or aesthetics). Drawdown can result in the rapid spread of highly opportunistic annual weed species, which in most cases is the plant that is targeted for control.

Drawdowns have been used in the past for plant control. In theory, the drying of the plants in the summer, or the freezing of the plants in the winter, will eliminate or limit plant growth. However, milfoil often forms a more succulent terrestrial form during drawdown conditions and the succulent form of the plant can remain viable for long periods of time without submergence, making the practice ineffective. This strategy can be used for control of some native plant species.

### **Dredging**

Dredging is a means of physical removal of aquatic plants from the bottom sediments using a floating or land-based dredge. Dredging can create a variety of depth gradients creating multiple plant environments allowing for greater diversity in lakes plant, fish, and wildlife communities. However due to the cost, potential environmental effects, and the problem of sediment disposal, dredging is rarely used for control of aquatic vegetation alone.

Dredging can take place in to fashion, including drawdown followed by mechanical dredging using an excavator, or using a diver-operated suction dredge while the water level remains up.

### **Biological Control**

There are no approved biological controls for submersed exotic aquatic plant at this time in New Hampshire.

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